PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Kyoung-sig ROH, et al.

Appln. No.: 10/803,968

Confirmation No.: 6471

Filed: March 19, 2004

Docket No: Q80077

Group Art Unit: 2629

Examiner: My Chau T. Tran

For: MAGNETIC SENSOR-BASED PEN-SHAPED INPUT SYSTEM AND A HANDWRITING TRAJECTORY RECOVERY METHOD THEREFOR

SUBMISSION OF EXECUTED DECLARATION UNDER 37 C.F.R. §1.131

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith is a copy of an executed Declaration Under 37 C.F.R. §1.131 signed by Kyoung-sik ROH, Won-chul BANG, Dong-yoon KIM, Wook CHANG, Kyoung-ho KANG and Eun-seok CHOK.

Respectfully submitted,

/Seok-Won Stuart Lee/

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WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: May 9, 2007

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DECLARATION UNDER 37 C.F.R. § 1.131

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

We, Kyoung-sig ROH, Won-chul BANG, Dong-yoon KIM, Wook CHANG, Kyoung-ho KANG and Eun-seok CHOI, hereby declare and state:

1. We are citizens of the Republic of Korea and the inventors of the invention entitled "MAGNETIC SENSOR-BASED PEN-SHAPED INPUT SYSTEM AND A HANDWRITING TRAJECTORY RECOVERY METHOD THEREFOR", disclosed and claimed in U.S. Patent Application No. 10/803,968 (hereinafter "present application") which claims the benefit of Korean Patent Application No. 10-2003-0017143, filed March 19, 2003, in the Korean Intellectual Property Office.

2. The Assignee of the present application by virtue of an assignment recorded at the U.S. Patent and Trademark Office at Reel No. 015122 and Frame No. 0325 on March 19, 2004, is Samsung Electronics Co., Ltd.

3. Prior to January 21, 2003, the invention of the present application was conceived, and further, the invention was constructively reduced to practice with diligence from a period prior to January 21, 2003, up to the filing of Korean Patent Application No. 10-2003-0017143 filed March 19, 2003, as evidenced by the following.

4. Prior to January 21, 2003, having earlier conceived the invention as set forth in the specification of the present application and Korean Patent Application No. 10-2003-0017143, the present invention was formally submitted to the Patent Department of Samsung Electronics Co., Ltd., in the form of an "Invention Report" and an "Invention Description," on November 20, 2002, which are attached as Exhibits "A" and "B," respectively.

5. The Invention Report and the Invention Description completely disclose the present invention as set forth and claimed in at least claims 1-8 in the present application.

6. Nawoo Patent & Law Firm, a patent law firm in the Republic of Korea representing Samsung Electronics Co., Ltd., for the invention disclosed in the present application, proceeded to prepare a patent application after receiving November 21, 2002, authorization from Samsung Electronics Co., Ltd., as shown in Exhibit "C".

7. In the ordinary course of business, Nawoo Patent & Law Firm prepared the patent application. The patent application was subsequently filed at the Korean Intellectual Property Office as " MAGNETIC SENSOR-BASED PEN-SHAPED INPUT SYSTEM AND A HANDWRITING TRAJECTORY RECOVERY METHOD THEREFOR" in Korean Patent Application No. 10-2003-0017143 filed June March 19, 2003.

HANDWRITING TRAJECTORY RECOVERY METHOD THEREFOR" in Korean Patent Application No. 10-2003-0017143 filed June March 19, 2003.

We declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: May 7, 2007 — Kyoung-sig ROH

Date: May 7, 2007 — Won-chul BANG

Date: May 7, 2007 — Dong-yoon KIM

Date: May 7, 2007 — Wook CHANG

Date: May 7, 2007 — Kyoung-ho KANG

Date: May 7, 2007 — Eun-seok CHOI

EXHIBITS A, C

국내출원 상세내역

Family NO. RE-200211-040-1 국내원문보기

발명명칭	Magnetic Compass Sensor를 이용한 Pen Input Device	진행상태	위임

Pen input device using magnetic compass sensor

발 명 자 (국내)

Inventors

성 명	영 문	한 문	주민번호	전화번호	H.P
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서울특별시 강남구 청담동 삼익APT 5-701					재직
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최은석	Choi Eun Seok	崔恩碩	730316-1357120	82312808058	017-621-2747
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서울특별시 강남구 도곡2동 453-3 서초빌라 나-101					재직

직 무 발 명

Submission date to IP Group : Nov. 20. 2002

작성(상신일)	2002/11/20	부서장 결재일	2002/11/20
특허부서 접수일자	2002/11/20	접수번호	RE-200211-040-1
사건구분	자체발명	관리소속	REK

선행기술조사

의뢰일자	-	회신일자	-
조사업체	-	조사자	-

발 명 평 가

발 명 자	일자	2002/11/20	등급	-
발명부서장	일자	2002/11/20	등급	
출원담당자	일자	2002/11/20	등급	A급
평가위원회	일자	2002/11/20	등급	A급

Nov. 21, 2002

국내결정사항

담당자 결정사항

결정일자	2002/11/20	결정내용	일반출원
권리구분	특허	심사청구(특허)	청구
기술평가(실용)	-	現출원담당자	서중우
출원인	삼성전자	-	-

Nawoo Patent & Law Firm

위원회 결정사항

결정일자	2002/11/20	결정내용	일반출원
권리구분	특허	심사청구(특허)	청구
기술평가(실용)	-	-	-

관 련 번 호

접수번호	출원번호	진행상태

해외결정사항

우선권마감일	-	-	-
결정일	2002/11/20	결정내용	海출원)일반

번역문

	국문	영문	일문
번역문접수일	-	-	-
검토통보일	-	-	-
명 세 면 수	0		
도 면 면 수		0	0
도 면 수	0		
작 성 자	-		

해외출원(결정)국가

해외접수번호	국 가	출원방법	출원종류	해외출원일	해외대리인
RE-200211-040-1-EP0	유럽특허청	일반출원	E P O	-	Elkington & Fife
RE-200211-040-1-JP0	일본	일반출원	개별국가	-	SHINJYU OFFICE OF PATENT ATTOR
RE-200211-040-1-US0	미국	일반출원	개별국가	-	LEE & STERBA, P.C

위 임 정 보 — Assignment (Filing in Korea/Oversea) Date of Assignment : Nov. 21, 2002

위임 1차	국/해외출원	위임일자	2002/11/21
위임의견	-		

공 개 기 보

의뢰일자	-	의뢰업체	-
게시일자	-	공기번호	-

초 안 정 보 ■ 국내초안사무소담당자 : -

출 원 정 보

출원일자	-	출원번호	-	출원종류	-
독립항수 (최초/현재)	/	종속항수 (최초/현재)	/	항 수 합 (최초/현재)	/
명세면수	0	도면면수	0	도 면 수	0

심 사 청 구

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공 개 공 보

공개일자	-	공개번호	-

공 고 공 보(구)

공고결정	-		

공고일자	-	공고번호	-

등 록

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등 록 공 보

일자	-	IPC 코드	-	-	-

종 료

종료일자	-	종료사유	-

종료관련사건

접수번호	-	출원번호	-	진행상태	-

EXHIBIT B

[Detailed description of the invention]

[Object of the invention]

[The field of the invention and the prior art]

The present invention relates to an electronic pen data input device for a computer and a method thereof, and more particularly to an electronic pen data input device for a computer which wiredly or wirelessly transmits information on writing operations of an electronic pen using a three-axis acceleration sensor and an optical three-dimensional measuring device in a computer application, and a coordinate measuring method thereof.

Recently, in order to input content written using a pen to a personal portable device or a computer application, input devices including a two-dimensional sensor array such as an LCD tablet or a digitizer tablet have become widely used. Such input devices require two-dimensional sensor arrays having a comparatively wide area, and so need a separate sensing surface. Accordingly, this leads to inconvenience in carrying, additional space requirements, and high prices. As a result of technical development, personal portable devices have become smaller, reaching the size of a watch or wallet. Along with a trend towards miniaturization, the size of an input screen has also become smaller, and thus writing using a conventional tablet leads to difficulty in inputting data by natural writing means due to the small input space.

[Detailed description of the invention]

[Object of the invention]

[The field of the invention and the prior art]

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In order to solve the above problem, if it is possible to input writing on a general flat surface using only a single electronic pen without a physical tablet, natural writing input is enabled by providing a wider input space than with a conventional pen input device. In order to input a document or figure using such an electronic pen having a self-movement sensing method, location coordinates of the tip of the electronic pen need to be successively measured on the basis of reference coordinates. However, during most of the writing operation, the pen writes while in a "down" state while contacting the surface, and moves to a "up" state where it does not contact the surface. Accordingly, a means for closely measuring a value of the location in both the contact state and the non-contact state is required.

Conventional input devices such as electronic pens use two different methods, one of which is a method for measuring the coordinates of the pen tip from outside the pen, and the other of which is a method for measuring the movement of the pen tip from inside the pen.

In order to measure the coordinates of a pen tip from outside the pen, a three-angle measuring method (U.S. Patent No. 5,166,668), electromagnetic waves (U.S. Patent No. 5,977,958) and time of flights of ultrasonic waves (U.S. Patent No. 4,478,674) are used. In such methods, however, as a pen transmits a signal and an external device receives the signal, the main body of a portable device has to be

mounted with a receiver, reducing portability.

Moreover, in order to measure the coordinates of a pen tip from the inside of the pen, the inside of the pen senses the movement of the pen tip using the rotation of the ball (U.S. Patent No. 5,027,115), or the force of the pen (U.S. Patent No. 5,111,004, and U.S. Patent No. 5,981,883), but if the pen is lifted from the surface, the movement of the pen cannot be measured. In addition, a method for measuring the movement of the pen through double integrals using two-axis or three-axis acceleration sensors mounted in the pen (U.S. Patent No. 5,247,137, WO 94/09,447, and U.S. Patent No. 5,587,558) is suggested. However, it is difficult to mount the acceleration sensor in the pen tip, and if the sensor is mounted at a distance from the tip, a location error may be generated without taking into consideration the slant of the center axis of the pen. Additionally, as the acceleration signals are double-integrated, accumulation errors increase, and so it is difficult to measure the precise movement of the pen. In order to compensate such influences on the slant of the pen, A.T Cross (U.S. Patent No. 5,434,371) suggested moving an acceleration sensor element having two or more axes to the pen tip, and moving a signal process unit to the upper part of the pen, but the sensor element and the signal process unit are separate, so the influence of electric noise is high and ink cannot be mounted near the tip of the pen. Seiko (Japanese Patent No. 6-67,799) suggested measuring the location by double integrals using two axis

acceleration and a two axis Gyro and measuring the slant angle of the pen by integrating the angular velocity of the pen. Richo (U.S. Patent No. 5,902,968 and U.S. Patent No. 5,981,884) suggested measuring the location of the pen tip which performs general three-dimensional writing by mounting a three axis acceleration sensor and a three axis Gyro sensor in the pen. However, as a surface for inputting the writing must always be perpendicular to the direction of the gravitational force, there are restrictions on the usage of such sensors. Furthermore, in methods using inertial sensors (acceleration and Gyro sensors), the acceleration and angular velocity are measured using double integrals and integrals, respectively, but as a result of noise from a sensor signals and drift, cumulative errors increase in proportion to the square of the factorial of time in the case of an acceleration meter, or in proportion to time in the case of a Gyro. Accordingly, precise movement of the pen tip cannot be measured.

[Technical object of the invention]

In order to solve the above problems, the present invention provides an electronic pen data input device for a computer, which reduces cumulative accumulation errors of inertial sensors, and precisely tracks the successive movement of the electronic pen when performing a writing operation on a general flat surface at a certain slant or when the electronic pen is lifted from the surface, and a coordinate measuring method thereof.

[Construction of the invention]

In order to achieve the above object, the present invention provides an electronic pen data input device for a computer, comprising:

an optical three-dimensional magnetic sensor which measures the slant in accordance with absolute coordinates (gravitational force coordinate system) of the center axis of the electronic pen;

a three axis acceleration sensor which measures the moving distance according to the three-dimensional movement of the electronic pen; and

a communication unit which transmits the measured information to an external operation device.

[Operation of the invention]

FIG. 1 illustrates the construction of the present invention.

1: magnetic sensor

2: acceleration sensor

3: data processing unit

4: control unit

5: battery

7: communication unit

FIG. 2 is a flow chart illustrating a pen input method using a conventional

acceleration meter and a Gyro sensor.

The pen input comprises an initial slant angle computation step in which an initial slant angle of the pen is measured using a three axis acceleration value obtained from the acceleration meter;

a slant angle change computation step in which a slant angle change of the pen is measured using a Gyro value measured when the pen moves;

a slant angle computation step in which a slant angle of the pen is measured using the initial slant angle and the slant angle change;

a coordinate conversion step in which an acceleration signal is converted from the slant angle of the pen to coordinates of the writing surface; and

an integral step in which the trace of the pen is measured by integrating the acceleration on the writing surface.

The first shortcoming of the conventional method is that the accuracy of the trace of the pen depends on the accuracy of the slant angle calculated by the Gyro sensor, and relative coordinates, not absolute coordinates, are acquired.

The second shortcoming is that in a system in which the value of coordinates has to be occasionally reset in order to avoid cumulative errors of the acceleration signal, the relation to existing values cannot be known.

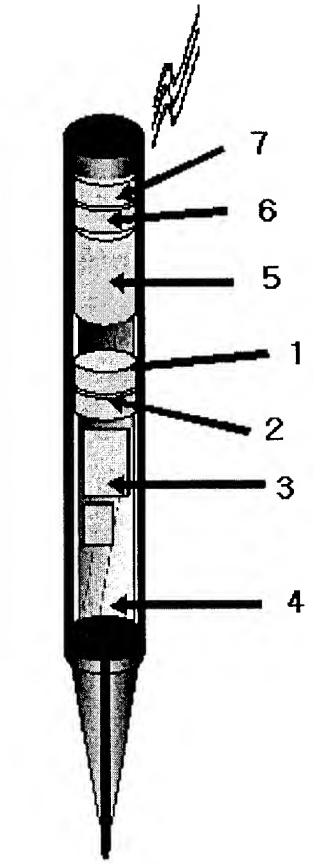
In order to solve such problems, the present invention can obtain absolute

coordinates and solve the above two problems by applying a magnetic sensor which does not require integrals.

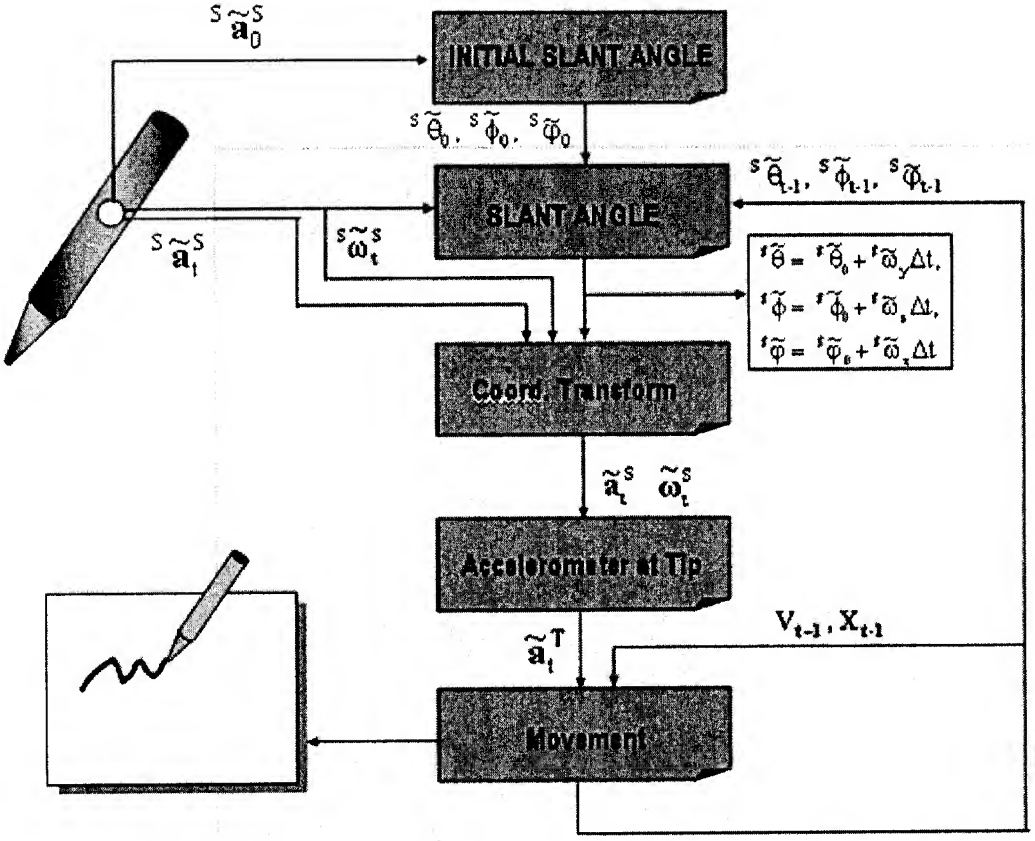
The magnetic sensor provides a value of a slant relative to terrestrial magnetism, and provides an angle value, not a changed amount, so the above problems can be solved.

A flow chart illustrating compensation of the trace of a pen using a magnetic sensor is shown in FIG. 3.

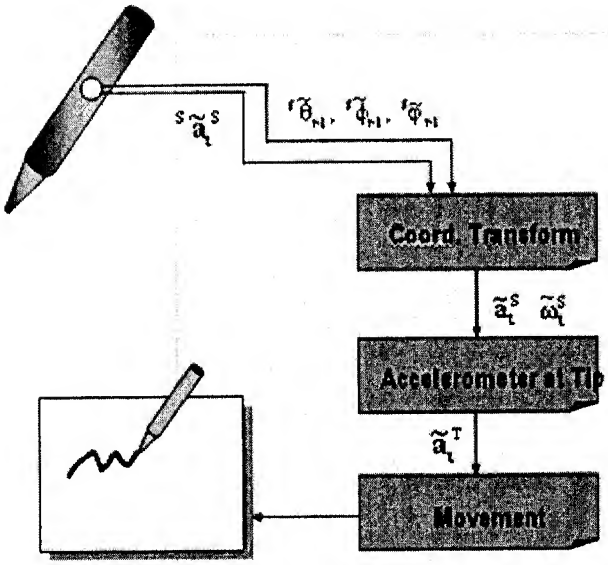
[FIG. 1]



[FIG. 2]


INITIAL SLANT ANGLE
SLANT ANGLE
Coord. Transform
Accelerometer at Tip
Movement

[FIG. 3]


Coord. Transform
Accelerometer at Tip
Movement

VERIFICATION OF A TRANSLATION

I, the below undersigned translator, hereby state and declare that:

a) My name and post office address are as stated below.

b) That I am well acquainted with the English and Korean languages.

c) That the following are correct translations into English of the Invention Description of Samsung Electronics Co., Ltd., for the Korean Patent Application No. 10-2003-0017143, and the Korean Patent Application No. 10-2003-0017143, filed on March 19, 2003, and I make the solemn declaration conscientiously believing the same to be true.

May 4, 2007
Date

Mi Yeon CHUNG

Signature of Translator

c/o Nawoo Patent & Law Firm

8th Floor, Daelim Building 1600-3

Seocho-dong, Seocho-gu, Seoul

MAGNETIC SENSOR-BASED PEN-SHAPED INPUT SYSTEM AND A HANDWRITING TRAJECTORY RECOVERY METHOD THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a pen-shaped input system, and more particularly, to a pen-shaped input system and a handwriting trajectory recovery method that are designed to recover handwriting strokes on the two-dimensional plane or in the three-dimensional space.

2. Description of the Related Art

In recent, the markets for personal mobile devices such as PDAs, cellular phones, notebooks, and so on, have been widely spread. It can be stated that such personal mobile devices are most fit for ubiquitous environments allowing information utilization anytime and anywhere since they are easy to be carried. That is, the recent mobile devices are designed to enable users to utilize information during their movements, greatly changing the existing paradigm, unlike the past environments confining information utilization to desktop personal computers (PCs) installed at homes.

However, such mobile devices are easy to be carried, but become smaller in an overall size thereof, which causes a problem that users feel somewhat inconvenient in recognizing information through a display unit and inputting commands. Moreover, the display screen of a portable terminal is being gradually reduced in the technical

trends that the portable terminal becomes gradually smaller into a watch-shaped or a wallet-shaped terminal, so that the exiting information input method can not but have its limitation. In such mobile devices, being easy to carry runs counter to being easy to input information, so researches and developments have been continuously made on methods for overcoming the problems.

As such research results, diverse devices have been proposed that can solve information input problems by using a single electronic pen only on a general plane without a physical tablet. Pen-shaped input devices currently commercialized or in research and development can be greatly classified into two kinds. The first approach is to measure coordinates of a pen tip outside the pen, and the second approach is to measure pen movements inside the pen.

For the types for measuring the coordinates of the pen tip outside the pen, there exist a type for using triangulation, a type for using electromagnetic waves or ultrasonic waves, a type for using the ultrasonic waves and acceleration sensors in combination, and so on. However, the types measuring the coordinates of the pen tip outside the pen have a problem of cost increase and inconvenience in carrying since extra sensors are needed to externally detect pen movements.

In the meantime, for the type measuring the coordinates of the pen tip inside the pen, there exist a type for using the rotations of a ball mounted on the pen tip, and a type for using measured force exerted on the pen. However, these types have a drawback in that pen movements cannot be detected if a pen is not in contact with the two-dimensional plane.

Further, as the type for measuring the coordinates of the pen tip inside the pen, there exists another type that obtains pen movements by using 2-axis or 3-axis acceleration sensors mounted inside the pen. However, this type has a problem of high possibility of errors due to influences of central axis tilting not considered since the type mounts the acceleration sensors on the central portion of the pen rather than on the pen tip. Further, in calculating position movements through the double integral for acceleration signals, there exists a problem of difficulties in measuring precise movements since accumulative errors increase as time lapses.

In order to solve the problem of pen tilting angles based on the positions at which the sensor is mounted, United States Patent No. 5,434,371(laid-open June 18, 1995) discloses an approach that moves 2- or 3 -axis acceleration sensors to the pen tip and a signal processor to the upper portion of the pen. However, the approach disclosed in the U.S. Patent No. 5,434,371 has a problem in that it is greatly affected by electrical noise and ink cannot be mounted in the pen tip portion since the sensor and the signal processor are separated. Further, U.S. Patent No. 6,181,329 (laid-open January 30, 2001) discloses an approach for obtaining positions of the pen in general three-dimensional movements with 3-axis acceleration sensors and 3-axis gyro sensors built in the pen. However, the U.S. Patent No. 6,181,329 recovers handwritings based on the sensor-mounted position rather than the pen tip for the recognition position, so that it has a problem of difficulties in precise recovery due to noise and the like.

The above systems for recovering users' handwritings by using inertia measurement values such as acceleration information generally employ theories for the

Inertial Navigation System (INS) widely used in military and navigation fields. The INS calculates navigation information such as positions, velocities, attitudes, and so on, for objects moving in the three-dimensional space by using inertia measurement values. Theoretically, the strapdown INS (SDINS) can obtain necessary information on objects of three-dimensional movements only with 3-axis accelerations and 3-axis angular velocities. The SDINS calculates the attitudes of the system and compensates for accelerations by using integral values for angular velocity measurement values, calculates velocities by integrating the compensated accelerations once, and calculates position information by integrating the accelerations twice.

However, in obtaining positions and angles through the double integral of accelerations and the integral of angular velocities with the inertia navigation method applied, there exist difficulties in calculating precise three-dimensional movements since accumulative errors due to noise or drift of signals outputted from the sensors increase in proportion to the square of the time in case of the accelerometer and in proportion to the time in case of the angular velocity meter.

SUMMARY OF THE INVENTION

Accordingly, it is an aspect of the present invention to provide a pen-shaped input system and a handwriting-tracking method that can precisely track handwritings on the two-dimensional plane or in the three-dimensional space with accumulative errors due to inertia sensors reduced.

In order to achieve the aspect of the present invention, a pen-shaped input system according to the present invention comprises a magnetic field detection unit mounted in a pen-shaped body of the system, and for detecting a tilt angle of the body based on movements of the pen-shaped body; an acceleration detection unit mounted in the pen-shaped body, and for detecting respective axial directions of the three-dimensional movements of the pen-shaped body; and a control unit for calculating absolute coordinates of the movements of the pen-shaped body from the information measured through the magnetic field detection unit and the acceleration detection unit.

The control unit converts 3-axis acceleration measurement values detected from the acceleration detection unit into measurement values of the pen-shaped body, and applies the converted measurement values of the pen tip for the absolute coordinate calculation.

Further, the pen-shaped input system further comprises a communication module for transmitting data to external computing devices, wherein the control unit controls the communication module to transmit the information measured from the magnetic field detection unit and the acceleration detection unit to the external computing devices.

In order to achieve the above object, a coordinate measurement method for a pen-shaped input system according to the present invention comprises steps of detecting a tilt angle and respective three-dimensional axial direction accelerations based on movements of a pen-shaped body of the system from a magnetic field detection unit and an acceleration detection unit mounted in the pen-shaped body; and calculating absolute

coordinates of the pen-shaped body from the information detected through the magnetic field detection unit and the acceleration detection unit.

Further, the coordinate measurement method further comprises a step of converting the 3-axial acceleration measurement values detected from acceleration sensors into an acceleration value of the pen tip of the pen-shaped body, wherein the step of calculating the coordinates of the pen-shaped body calculates the coordinates of the pen-shaped body with the acceleration value of the pen tip applied.

Further, the coordinate measurement method further comprises a step of transmitting the information measured from the magnetic field detection unit and the acceleration detection unit into the external computing devices.

As aforementioned, the pen-shaped input system and the coordinate measurement method therefor according to the present invention can obtain absolute coordinate values as tilt angles are precisely measured through a magnetic sensor, so as to enhance the precision degree for pen movement tracking, and the system and method according to the present invention can prevent conventional accumulative errors occurring as acceleration signals are integrated, so as to perform signal processing operations faster.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic block diagram for showing a pen-shaped input system according to an embodiment of the present invention;

Fig. 2 is a view for showing a schematic structure of the pen-shaped input system of Fig. 1; and

Fig. 3 is a view for explaining signal processing operations of the pen-shaped input system of Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, the present invention will be described in detail with reference to the accompanying drawings.

Fig. 1 is a schematic block diagram for showing a pen-shaped input system according to an embodiment of the present invention. A system 100 includes a magnetic field detection unit 112, an acceleration detection unit 114, a display unit 120, a transmission/reception unit 130, and a control unit 140.

The magnetic field detection unit 112 uses a magnetic field detection sensor, and detects a tilt angle of a pen-shaped body of the pen-shaped input system based on attitude changes of the body according to motions of the pen body.

The acceleration detection unit 114 detects respective three-dimensional axial accelerations based on the movements of the pen-shaped body.

The display unit 120 displays the motions of the pen-shaped body, that is, handwriting trajectory on a screen. In here, the display unit 120 may be built in the pen-shaped input system into one body, or may be a displayable unit built in the other systems.

The transmission/reception unit 130 transmits to the other systems tilt angle information and acceleration information measured through the magnetic field detection unit and the acceleration detection unit under the controls of the control unit.

The control unit 140 calculates absolute coordinates of the pen body based on the tilt angle information and the acceleration information based on the movements of the pen-shaped body, and controls the display unit 120 to display handwriting trajectory performed in space or the transmission/reception unit 130 to transmit handwriting trajectory information to the other systems. At this time, the control unit 140 converts the acceleration information detected through the acceleration sensors into measurement values of a pen tip of the body, and applies the measurement values of the pen tip for absolute coordinate calculations. Further, the control unit 140 may not process the information detected from the magnetic field detection unit 112 and the acceleration detection unit 114 inside the pen body, but only transfer the information to an external system performing a computing process through the transmission/reception unit 130. At this time, the external system performs the computing process for the control unit 140.

Fig. 2 is a view for showing a schematic structure of the pen-shaped input system of Fig. 1. The system has a magnetic field detection sensor 210, an acceleration detection sensor 220, a computing processor 230, a Main Control Unit (MCU) 240, a battery 250, a data storage 260, and a communication module 270. In here, the arrangement for the respective components of the system is not limited to Fig. 2, but can be made in diverse structures. Further, the computing processor 230 and the data

storage 260 may be built in the MCU 240. Further, even though not shown in Fig. 2, devices such as LEDs and speakers may be further mounted to display system states, and a LCD may be mounted to display a recovering status or the like for handwriting trajectory in space.

In order to grasp relative positions of the pen-shaped input system with respect to the absolute coordinate system in the three-dimensional space, the attitude of the system has to be calculated, and the acceleration measurement values of the pen-shaped body have to be converted into the measurement values in the absolute coordinates. The attitude of an object in the three-dimensional space is expressed in Euler angles, that is, in roll, pitch, and yaw, and the absolute coordinates of an object can be obtained when applied with a tilt angle detected through the magnetic field sensor 210 as to the attitude of an object obtained through the Euler angles. At this time, the detection position of the acceleration detection sensor 220 is the middle portion of the pen, so that conversions can be made into an acceleration value at the pen tip by using a distance to the pen tip from the detection position.

Fig. 3 is a view for explaining handwriting trajectory recovery operations for the pen-shaped input system of Fig. 2. First, in the pen-shaped input system, if pen movements occur, the acceleration detection sensor 220 measures and outputs to electrical signals respective accelerations of x-, y-, and z-axis directions, the magnetic field detection sensor 210 detects a tilt angle of the pen based on the geomagnetic field and outputs an electrical signal. Thereafter, the computing processor 230 converts into absolute coordinates of the pen based on the acceleration information and the tilt angle

information transferred from the respective sensors 210 and 220. Next, the computing processor 230 converts an acceleration value of the measured absolute coordinates into an acceleration value of the pen tip, so that handwriting trajectory can be restored with the acceleration value of the pen tip applied.

As stated above, the pen-shaped input system and the handwriting trajectory recovery method use a magnetic field sensor, so that accumulative errors occurring due to the integral in the system using inertia sensors can be prevented, and absolute values are obtained through a tilt angle, so that the processing speed can be enhanced since the signal processing is simplified.

Further, the present invention can solve a problem of inconvenient input operations in small-sized devices, and the present invention provides an intuitive interface so as to enable users to use an input system without specific learning courses, promoting users' convenience.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A pen-shaped input system using a magnetic sensor, comprising:

a magnetic field detection unit mounted in a pen-shaped body of the pen-shaped system, and for detecting a tilt angle of the body based on movements of the pen-shaped body;

an acceleration detection unit mounted in the pen-shaped body, and for detecting respective axial direction accelerations of the three-dimensional movement of the pen-shaped body; and

a control unit for calculating absolute coordinates of the movements of the pen-shaped body from information measured through the magnetic field detection unit and the acceleration detection unit.

2. The pen-shaped input system as claimed in claim 1, wherein the control unit converts 3-axis acceleration measurement values detected from the acceleration detection unit into measurement values of a pen tip of the pen-shaped body, and applies the converted measurement values of the pen tip for the absolute coordinate calculation.

3. The pen-shaped input system as claimed in claim 1, further comprising a communication module for transmitting data to external computing devices,

wherein the control unit controls the communication module to transmit the information measured from the magnetic field detection unit and the acceleration detection unit to the external computing devices.

4. A coordinate measurement method for a pen-shaped input system, comprising steps of:

detecting a tilt angle and three-dimensional axial direction accelerations based on movements of a pen-shaped body of the system from a magnetic field detection unit and an acceleration detection unit mounted in the pen-shaped body; and

calculating absolute coordinates of the pen-shaped body from the information detected through the magnetic field detection unit and the acceleration detection unit.

5. The coordinate measurement method as claimed in claim 4, further comprising a step of converting the 3-axial acceleration measurement values detected from the acceleration detection unit into an acceleration value of the pen tip of the pen-shaped body, wherein the step of calculating the coordinates of the pen-shaped body calculates the coordinates of the pen-shaped body with the acceleration value of the pen tip applied.

6. The coordinate measurement method as claimed in claim 4, further comprising a step of transmitting the information measured from the magnetic field detection unit and the acceleration detection unit into the external computing devices.

ABSTRACT OF DISCLOSURE

Disclosed is a pen-shaped input system designed to recover handwriting trajectory in space by using a magnetic field sensor. The system detects a tilt angle relative to the geomagnetic field from a magnetic field detection unit and an acceleration detection unit, and respective three-dimensional axial direction accelerations based on movements of the pen, and calculates the absolute coordinates of the pen. Further, the system converts the acceleration measurement values of the pen into a pen tip acceleration value, and applies the acceleration value for recovering handwriting trajectory of the pen. Such a pen-shaped input system uses the magnetic sensor so that it can prevent accumulative errors occurring due to integrations of the detected information when using inertia sensors, and the system can improve a processing speed since its signal processing is simplified.

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